Development of the COAMPS Adjoint Modeling System and Its Application to Storm Initialization Using SSM/I Observations

Xiaolei Zou
Dept. of Meteorology, Florida State University
404 Love Building, Tallahassee, FL 32306-4520
phone (850) 644-6025 fax (850) 644-9642 email zou@met.fsu.edu

Award number: N000140110375

LONG-TERM GOALS

Our long-term goal is to develop a 4-dimensional variational data assimilation system using COAMPS (Coupled Ocean/Atmosphere Mesoscale Prediction System), which could be used for many applications in mesoscale numerical weather prediction. The system can be used to assess the impact of remote-sensing observations on mesoscale and storm-scale prediction. The benefit of using 4D-Var than 3D-Var can also be tested. If computing power is increased, the system can potentially be used operationally at ONR.

OBJECTIVES

This ONR-related research focuses on three primary objectives:

1. Develop the COAMPS 4D-Var system - an effective, well-documented, and user friendly adjoint modeling system using COAMPS,

2. Applying the new system (once the COAMPS 4D-Var system is developed) to storm initialization using TPC (Tropical Prediction Center) observed parameters, and

3. Assimilate brightness temperature observations from Special Sensor Microwave Imager (SSM/I) obtained from a microwave radiometer system flown on DMSP satellites for hurricane initialization.

APPROACH

Technical approaches involve:

1. Four-dimensional variational data assimilation (4D-Var) with the COAMPS mesoscale model.

2. Adjoint sensitivity study.

The 4D-Var experiments assess the impact of various types of data, and the adjoint sensitivity calculations provide additional insights into the key components for model prediction.

Key individuals:

Report Documentation Page

Form Approved
OMB No. 0704-0188

1. REPORT DATE	2. REPORT TYPE	3. DATES COVERED
SEP 2001		**00-00-2001 to 00-00-2001**

4. TITLE AND SUBTITLE	5a. CONTRACT NUMBER
Development of the COAMPS Adjoint Modeling System and Its Application to Storm Initialization Using SSM/I Observations	5b. GRANT NUMBER
	5c. PROGRAM ELEMENT NUMBER
6. AUTHOR(S)	5d. PROJECT NUMBER
	5e. TASK NUMBER
	5f. WORK UNIT NUMBER
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) **Dept. of Meteorology, Florida State University,,404 Love Building,,Tallahassee,,FL, 32306**	8. PERFORMING ORGANIZATION REPORT NUMBER
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)	10. SPONSOR/MONITOR'S ACRONYM(S)
	11. SPONSOR/MONITOR'S REPORT NUMBER(S)

12. DISTRIBUTION/AVAILABILITY STATEMENT
Approved for public release; distribution unlimited

13. SUPPLEMENTARY NOTES

14. ABSTRACT
Our long-term goal is to develop a 4-dimensional variational data assimilation system using COAMPS (Coupled Ocean/Atmosphere Mesoscale Prediction System), which could be used for many applications in mesoscale numerical weather prediction. The system can be used to assess the impact of remote-sensing observations on mesoscale and storm-scale prediction. The benefit of using 4D-Var than 3D-Var can also be tested. If computing power is increased, the system can potentially be used operationally at ONR.

15. SUBJECT TERMS

16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON
a. REPORT	b. ABSTRACT	c. THIS PAGE			
unclassified	**unclassified**	**unclassified**	**Same as Report (SAR)**	**4**	

1. Drs. X. Zou and Q. Zhao: COAMPS 4D-Var system development, data assimilation, adjoint sensitivity study, and analysis of numerical results.

2. Graduate student Mr. Amerault: Development of a radiative transfer model for SSM/I brightness temperature, its tangent linear and adjoint models, adjoint sensitivity study, and analysis of numerical results.

WORK COMPLETED

The parallel scalable version of the Naval Research Laboratory's (NRL) Coupled Ocean/ Atmosphere Mesoscale Prediction System (COAMPS) has been thoroughly analyzed. An overall understanding of the COAMPS model system, especially the mechanism of communications among MPI sub-domains, has been achieved. A web page that includes hyper-links to the source code and called subroutines for each and every program /subroutine has been developed as an efficient reference. A tree structure of the model system has also been created. The tangent linear model is near completion.

The tangent linear and adjoint operators of a fast radiative transfer model, which are required for the direct assimilation of SSM/I microwave brightness temperatures, have been developed.

Evaluation of a storm initialization scheme using TPC observed parameters with SSM/I brightness temperatures.

RESULTS

No results to report at this stage. All the work was devoted to developing source codes.

IMPACT/APPLICATIONS

The COAMPS 4D-Var system is expected to improve mesoscale prediction using COAMPS and observations.

The study on the 4D-Var assimilation of the SSM/I brightness temperature gives a valuable contribution to hurricane track and intensity forecast.

TRANSITIONS

Upon finalizing the testing, the codes for the COAMPS 4D-Var system will be in the public domain.

RELATED PROJECTS

"Impact of radar, satellite and targeted *in situ* data on the hurricane forecasts near landfall", funded by NSF-USWRP under the project number ATM-9908939.

"Assimilation of Multi-Sensor Synoptic and Mesoscale Datasets: An Approach Based on Statistic, Dynamic, Physical and Synoptic Considerations", funded by ONR under the project number N00014-99-1-0022.

SUMMARY

A better understanding of the benefit of 4D-Var for mesoscale data assimilation could be tested. A step forward can be made towards improving the techniques for hurricane initialization. The ONR-sponsored work has helped strengthen our Data Assimilation Group, which is a trademark of our Department.